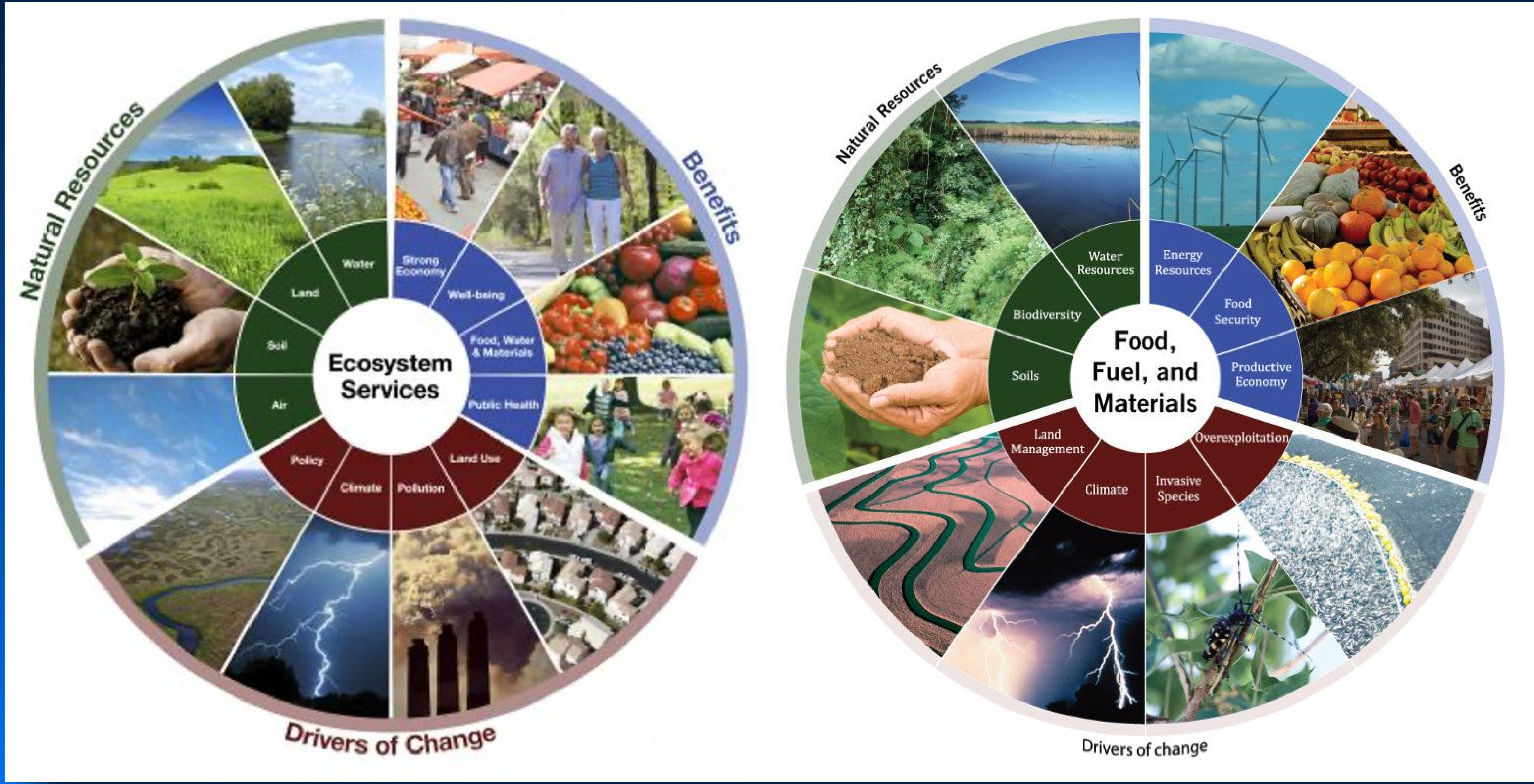
NJU Course

Principles of Paleobiology

Conservation Paleobiology

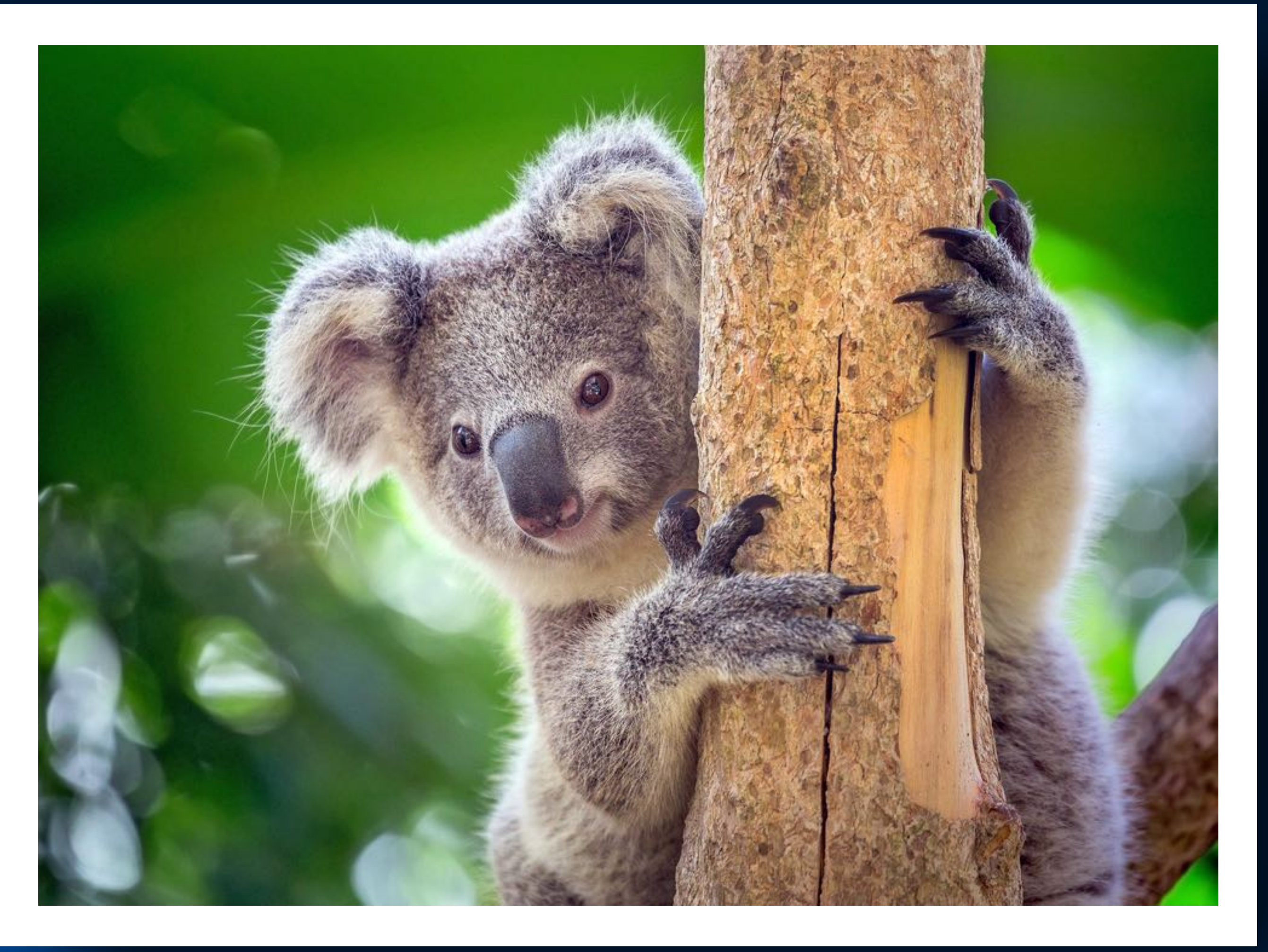


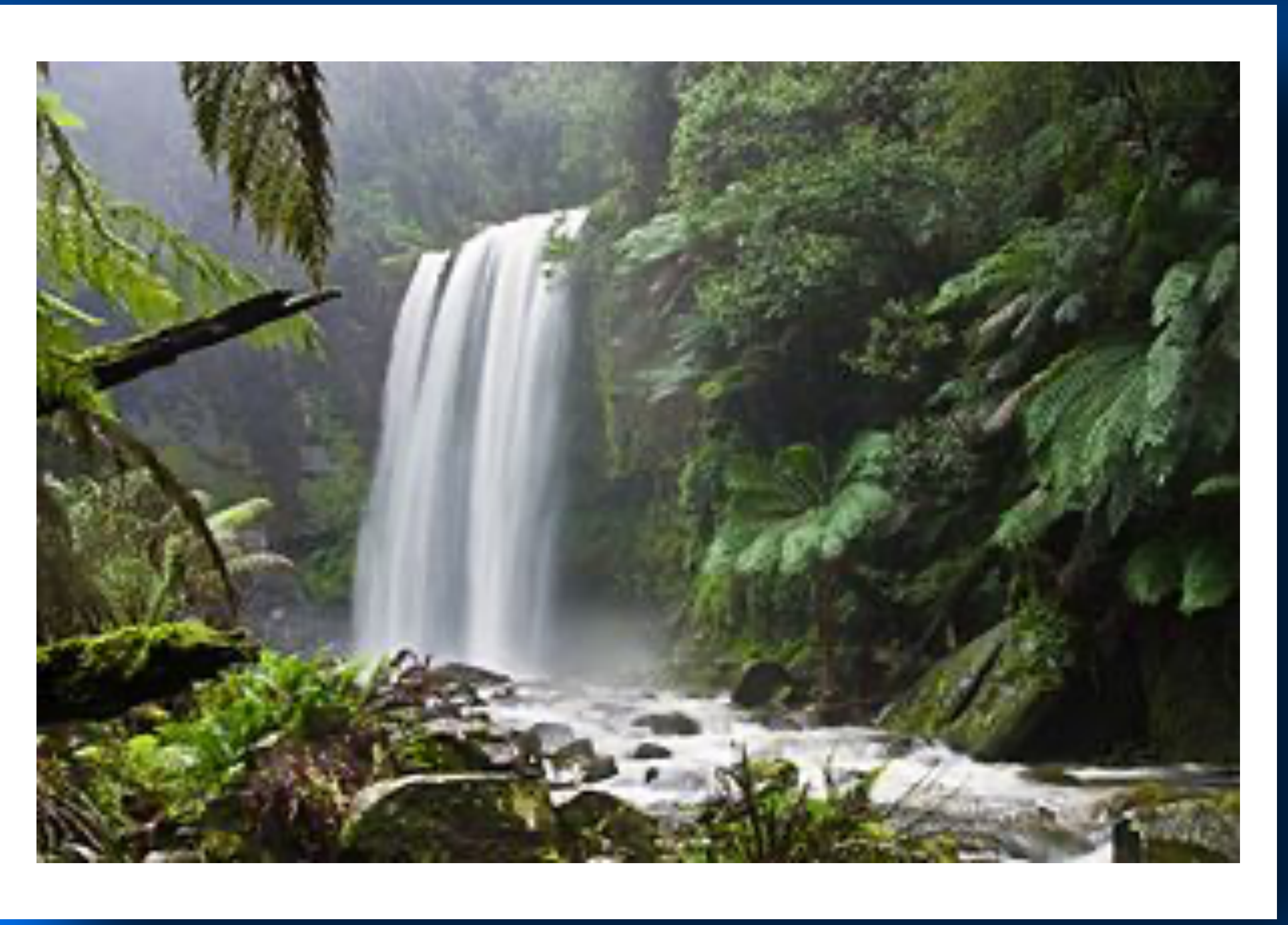
Conservation Paleobiology

Definitions

Conservation Biology - the study of physical biotic relations among Recent species and their environments for the purpose of protecting them, their habitats and ecosystems from being subjected to human-caused extinctions.

- Conservation Biology Foci
  - Biocentric Focus - the view that the focus of conservation biology should be on avoiding species loss by human-induced causes irrespective of any consideration for human well-being.
  - Anthropocentric Focus - the view that the focus of conservation biology should be on avoiding species loss with priority being given to those species that contribute to human well being.





Conservation Paleobiology

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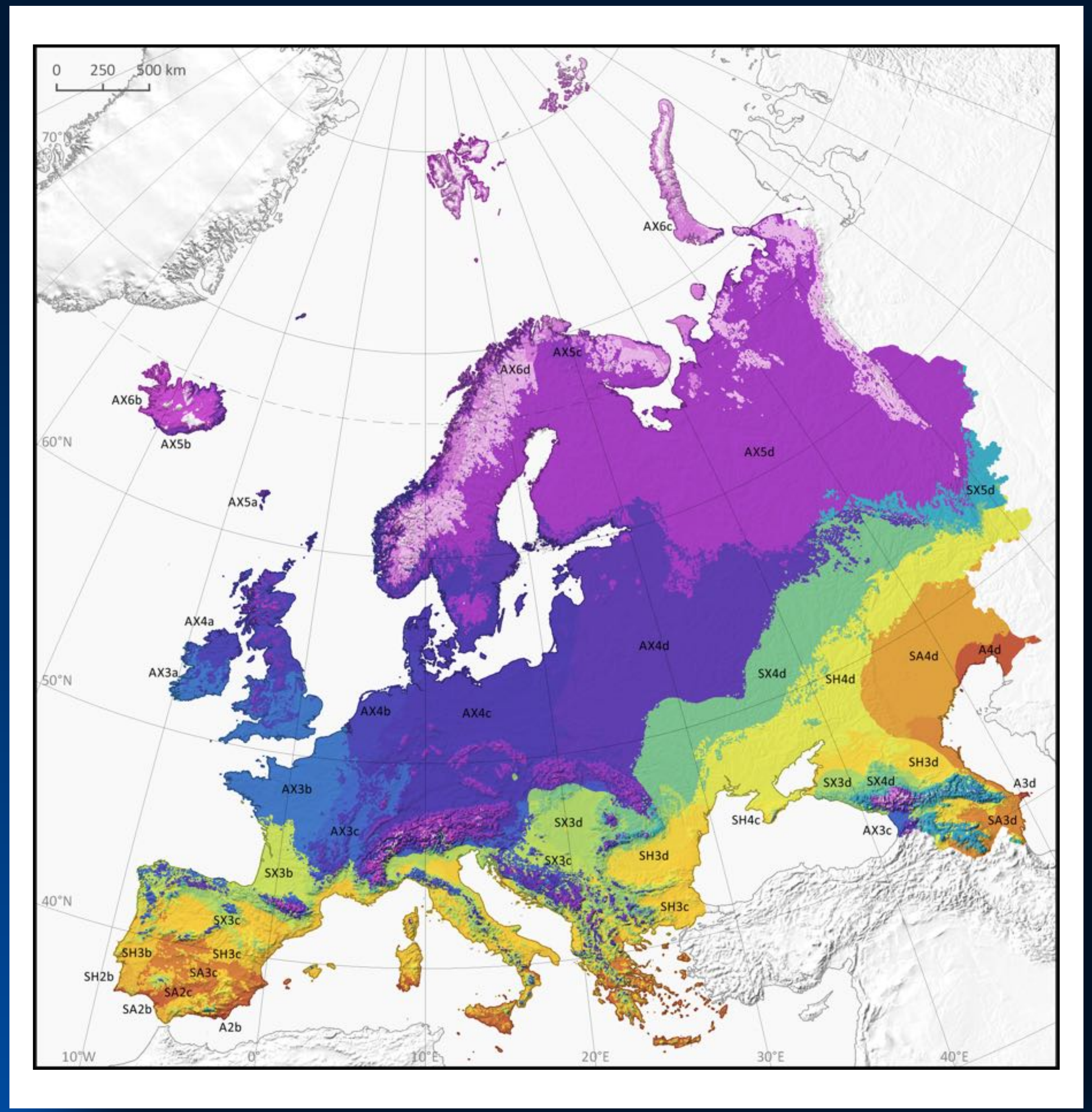
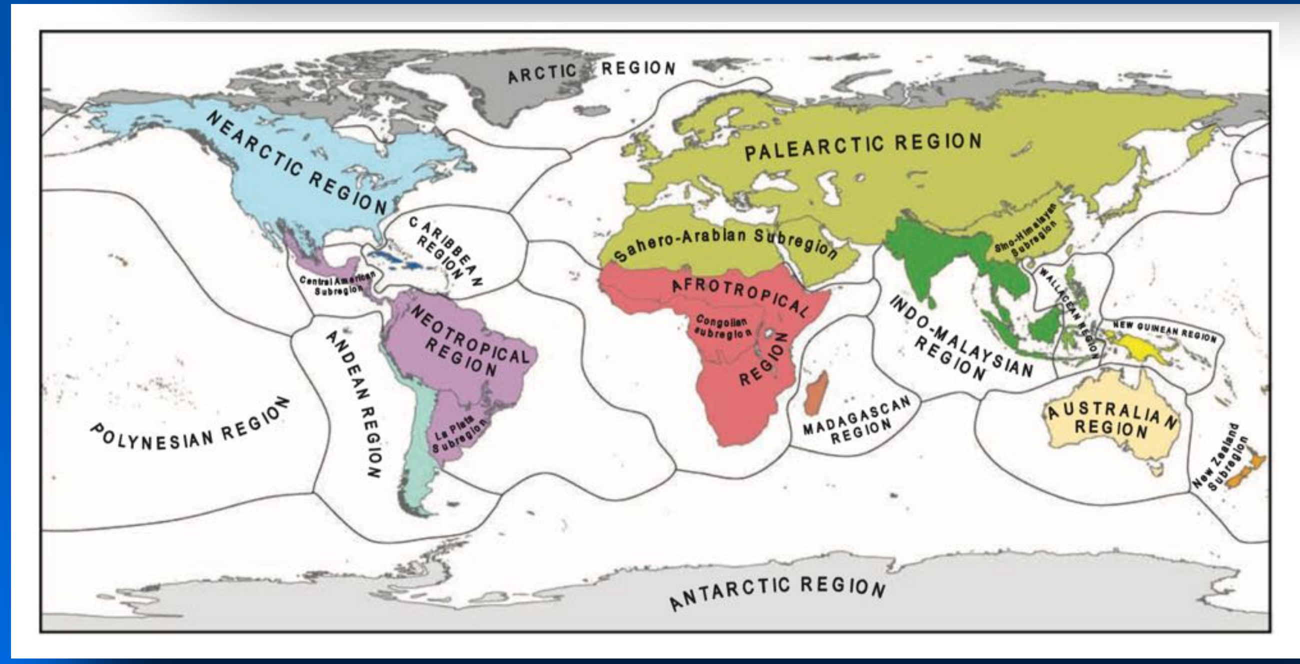




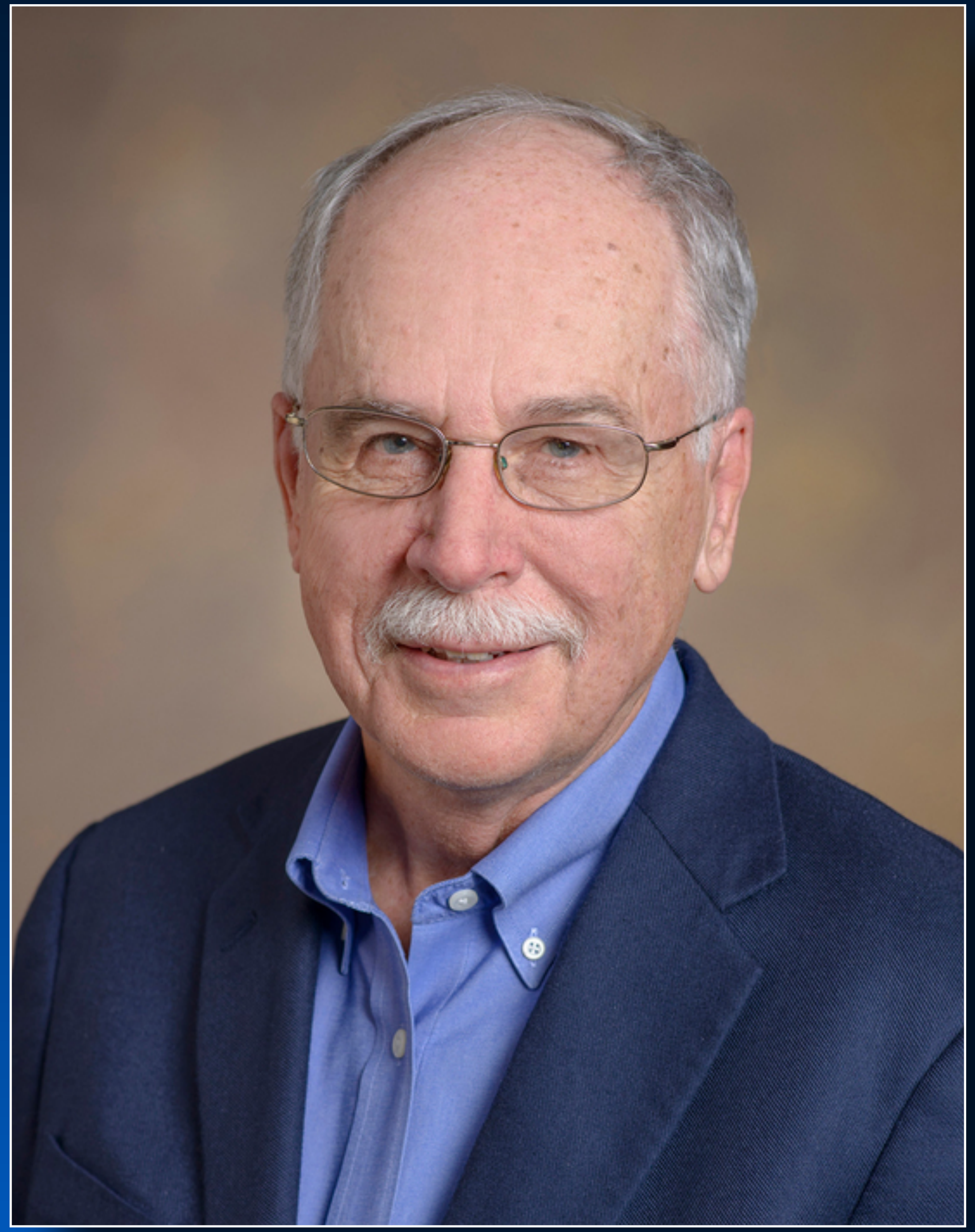
Conservation Paleobiology - The field of study that applies knowledge of the geological and paleontological record to the problems of biodiversity and ecosystem maintenance/ restoration. Arguably this is paleobiology’s newest sudiscipline, though it can be regarded as a rebranding exercise for paleoecology.

- Conservation Paleobiology Foci
  - Near-term - efforts to use the Late Pleistocene and Holocene fossil records to mitigate loss through a longterm context for understanding Recent ecosystem dynamics.
  - Deep-Time - efforts to use the fossil record to understand species responses to major episodes of environmental perturbation.

Conservation Paleobiology

Founders of Conservation Paleobiology

American paleontologist, author and researcher, Flessa has had a long-standing interest in paleocology and animal-sediment interactions throughout his long and very productive re-seach career. Beginning with the earliest nominal review of conservation paleobiology in 2011– *Conservation Paleobiology: Putting the Dead to Work* – Flessa, along with his student Greg Dietl, has been a leading light in the conservation paleobiology movement. He is also the co-author (along with Dietl) of the first textbook in the subject: *Conservation Paleobiology: Science and Practice*.

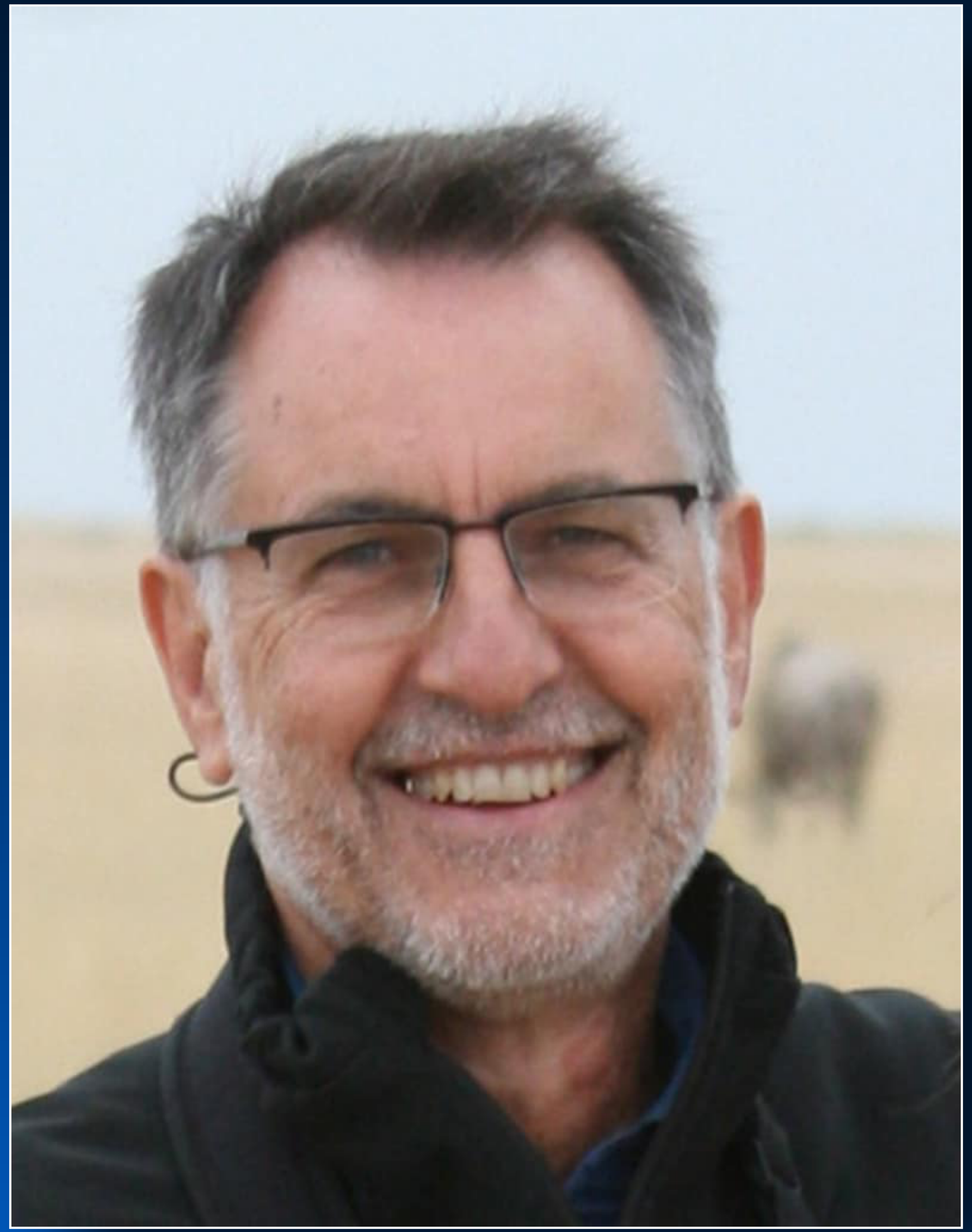


Karl Flessa
(b. 1932)

Conservation Paleobiology

Founders of Conservation Paleobiology

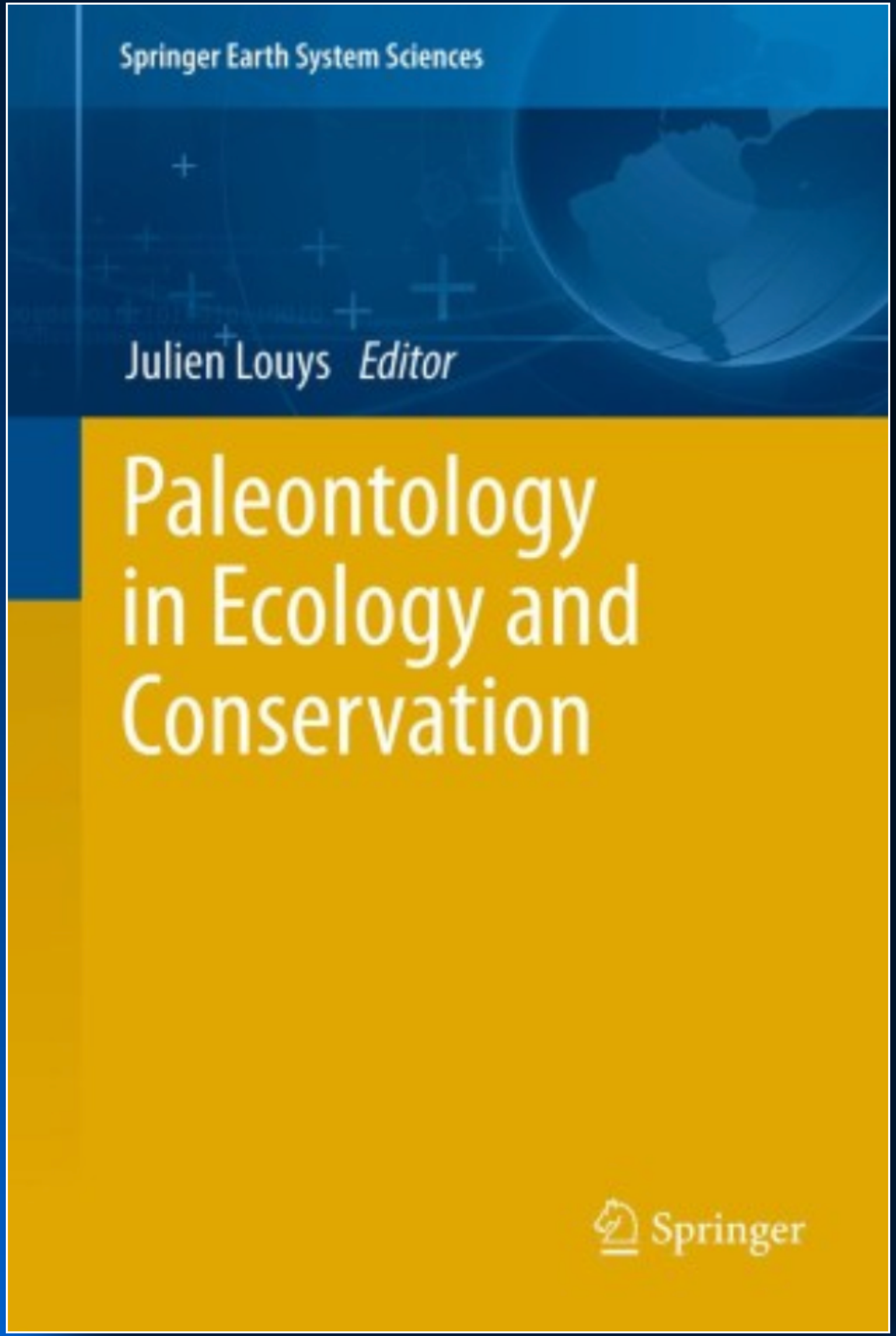
American ecologist, vertebrate paleontologist geologist and author, Barnosky' research has centered around the role climate change has played in causing vertebrate mass extinctions. Among his many contributions has been the concept of planetary-scale environmental "tipping points" that can cause fundamental and irreversible changes in planetary environmental states and might be a cause of at least some of the major "mass extinctions". Baronsky believes the impact of human populations on the Earth's environment has the potential to reach the tipping point level of past large igneous province (LIP) eruptions, ice ages and bolide impacts. Barnosky has also been a consistent and influential advocate of the role paleontological data can play in understanding present levels of susceptibility and threats to species' survival.



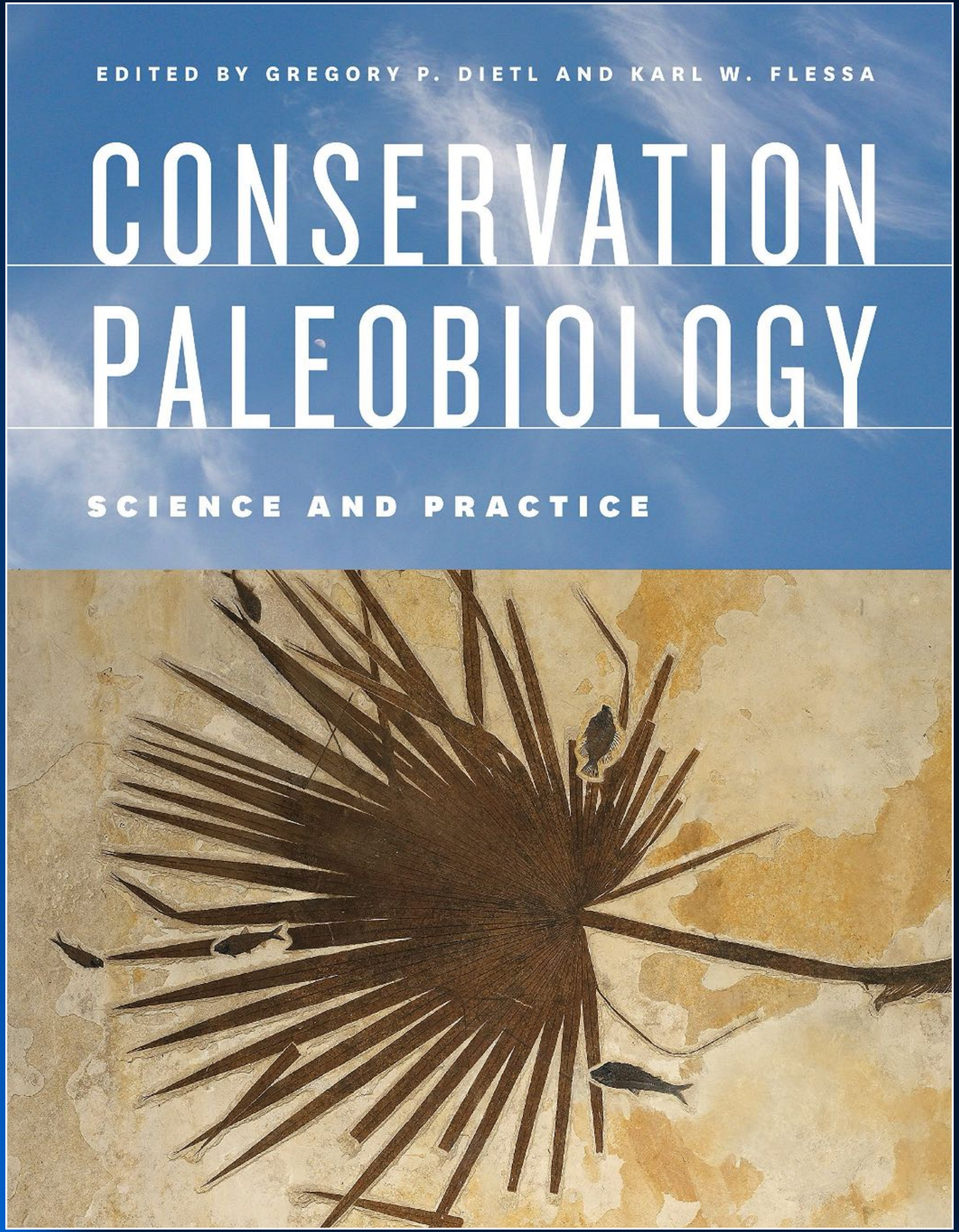
Anthony D. Barnosky
(b. 1952)

Conservation Paleobiology

Textbooks



Louys, J. (Editor) 2012, Paleontology in ecology and conservation: Berlin; New York, Springer, 273 p.



Dietl, G.P. and Flessa, K.W. 2017, Conservation paleobiology: science and practice: Chicago, Illinois, University of Chicago Press, 316 p.

Conservation Paleobiology

Science & Values

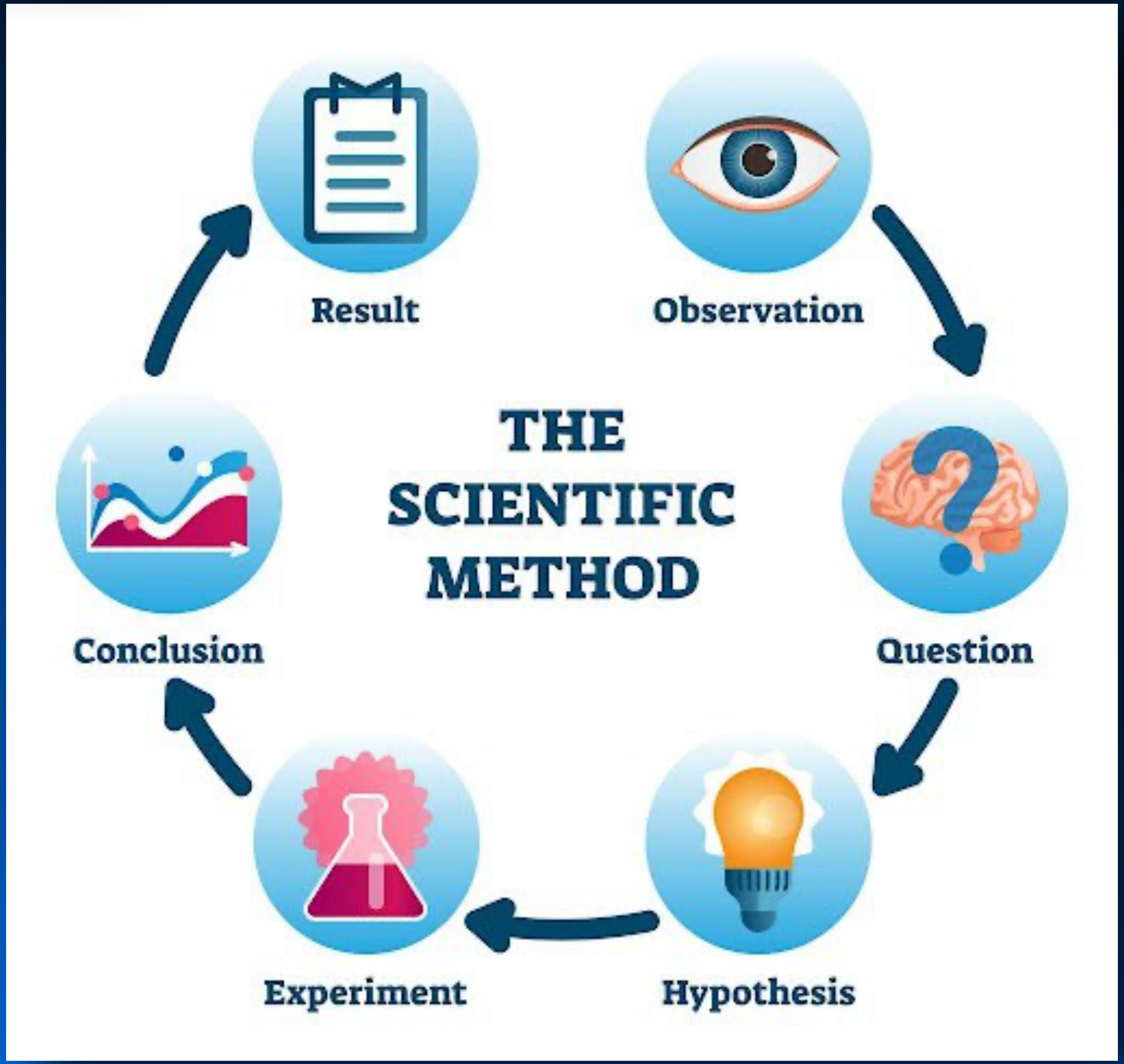
Diverging Opinions

- Reliable scientific knowledge is value free and has no moral or ethical value. Science tells us how the world is. ... Dangers and ethical issue arise only when science is applied as technology.

  - Louis Wolpert

- Conservation biologists should reflect on the constitutive values (especially contextual, but also methodological and bias) underlying their research programs and policy recommendations. Such reflection is itself an inherent element of scientific objectivity and takes into account the social nature of scientific knowledge.

  - Dwight Barry & Max Oelschlaeger



Conservation Paleobiology

Science & Values

Biocentrists ⟷ Anthropocentrists

Biocentrists

- Focus on the intrinsic value of biodiversity.
- Favor political/authoritarian action
- Are comfortable with state coercion if that is necessary
- Research focus on species-specific tolerances and ecological structure to mitigate extinction rates
- Research focus on avoiding further damage to ecosystems

Anthropocentrists

- Focus on the intrinsic value of human societies
- Favor popular support for conservation goals
- Value human freedom and self-determination
- Research focus on ecosystem services that enhance productivity and stability
- Research focus on restoration of damaged ecosystems

Conservation Paleobiology

Science & Values

Biocentrists ⟷ Anthropocentrists

Any risk is too great!

I like the odds, let's roll the dice!

Conservation Paleobiology

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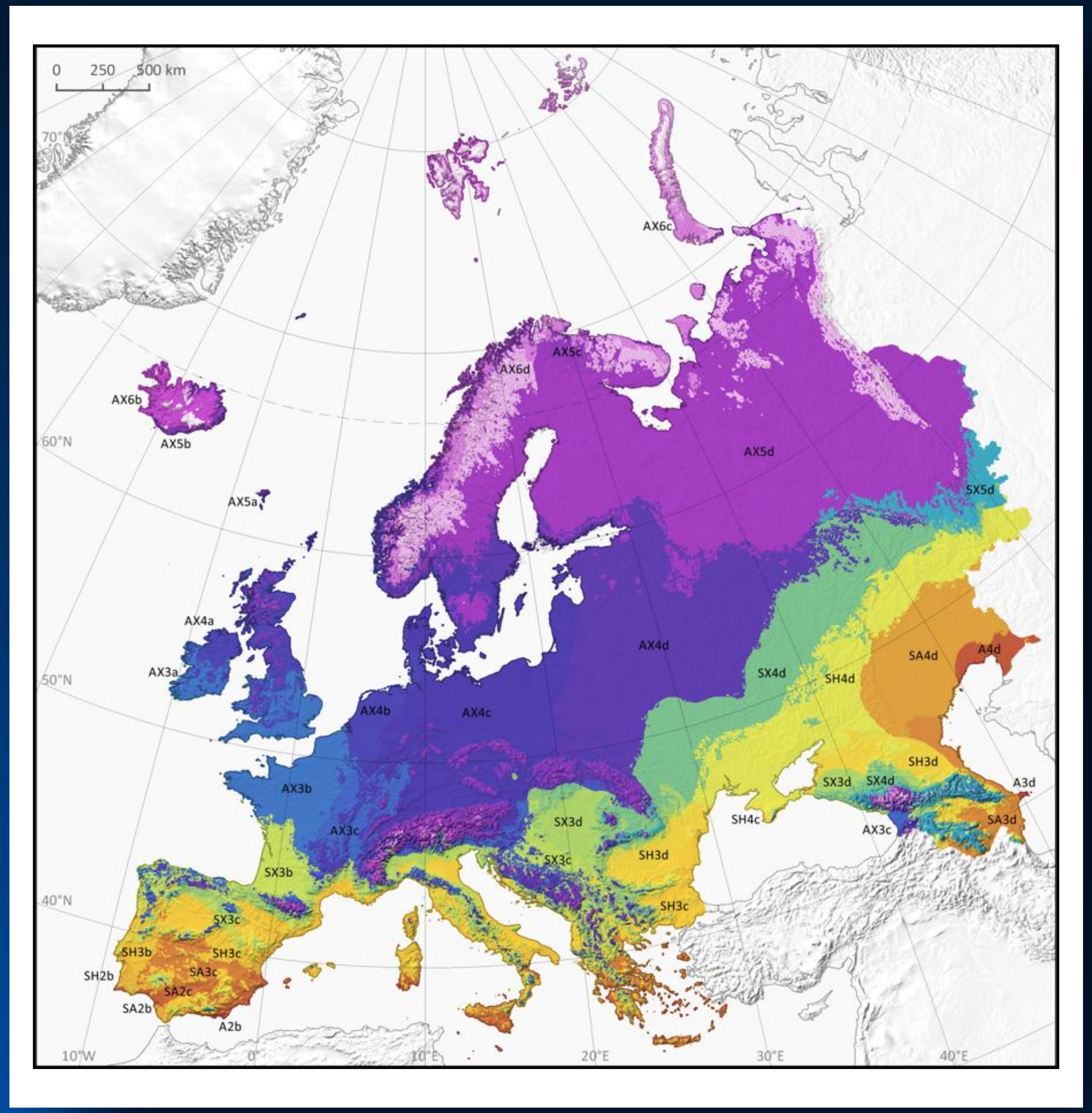

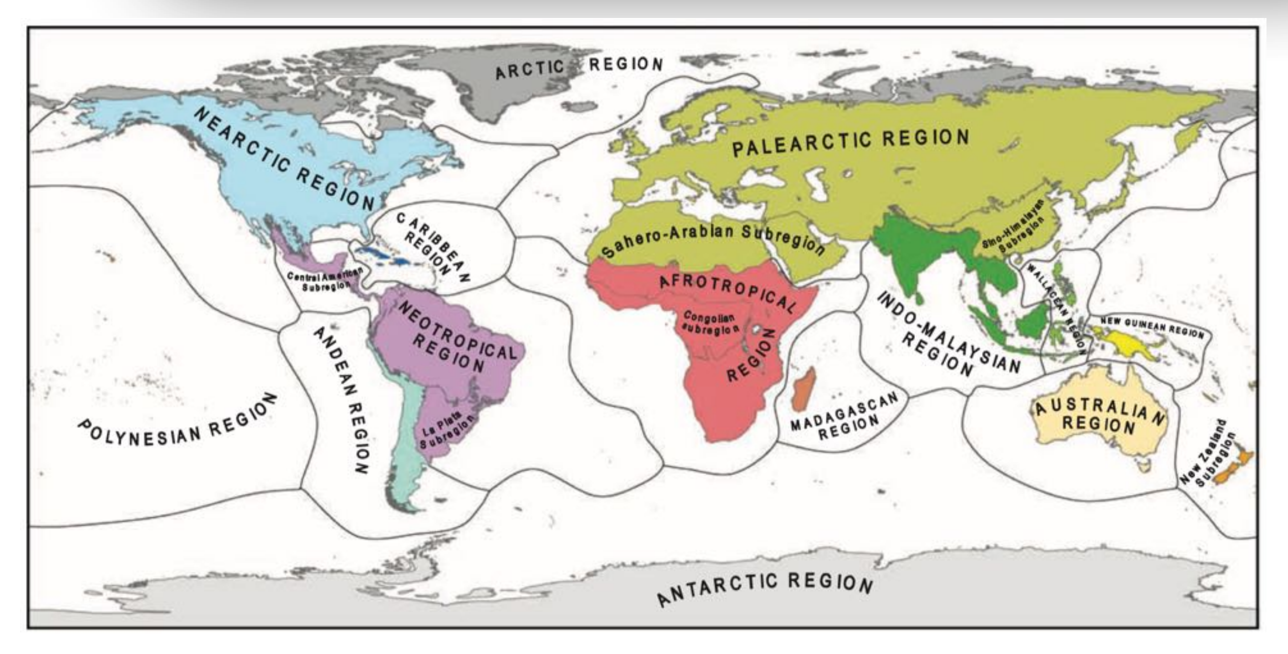

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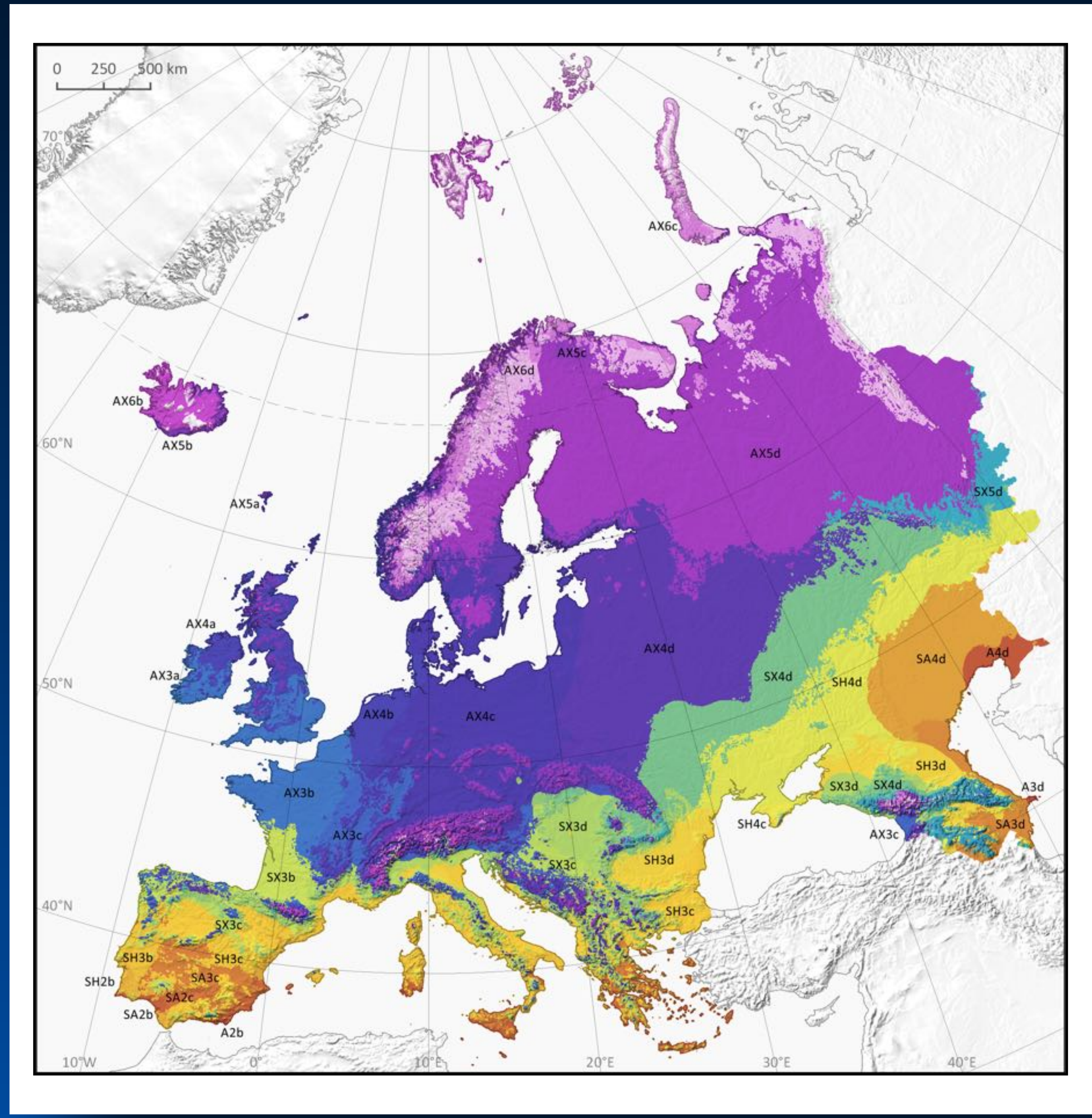

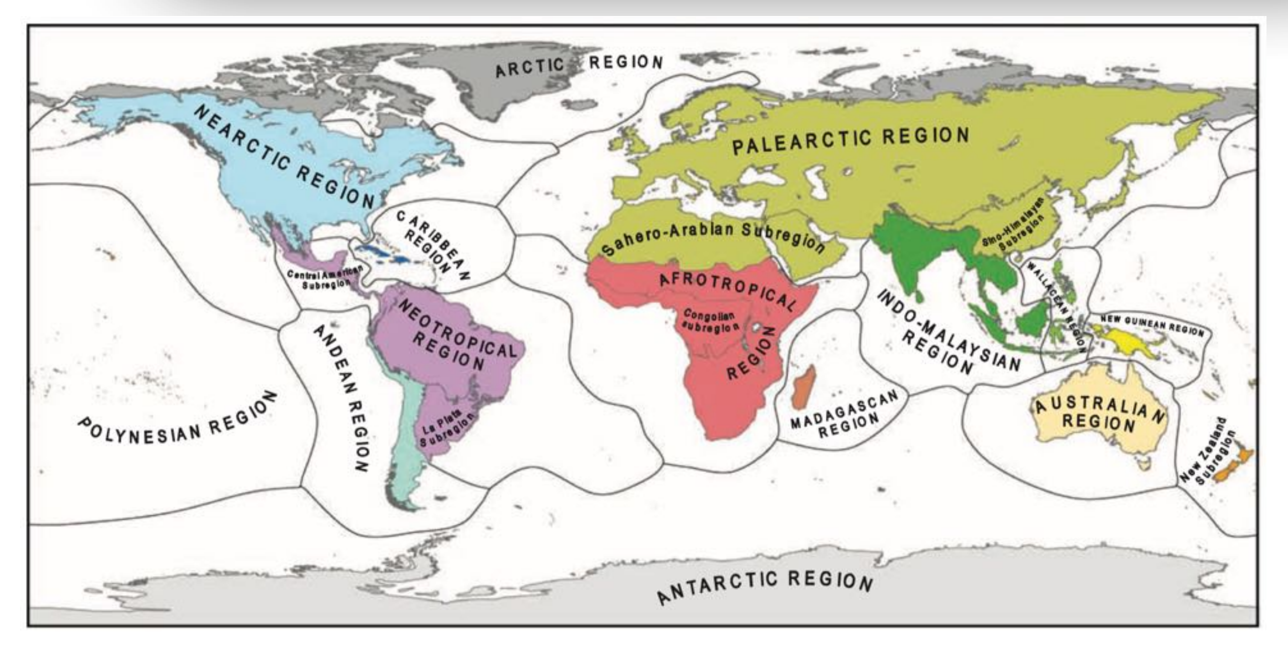

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Conservation Paleobiology

Ecological Composition of the Planet

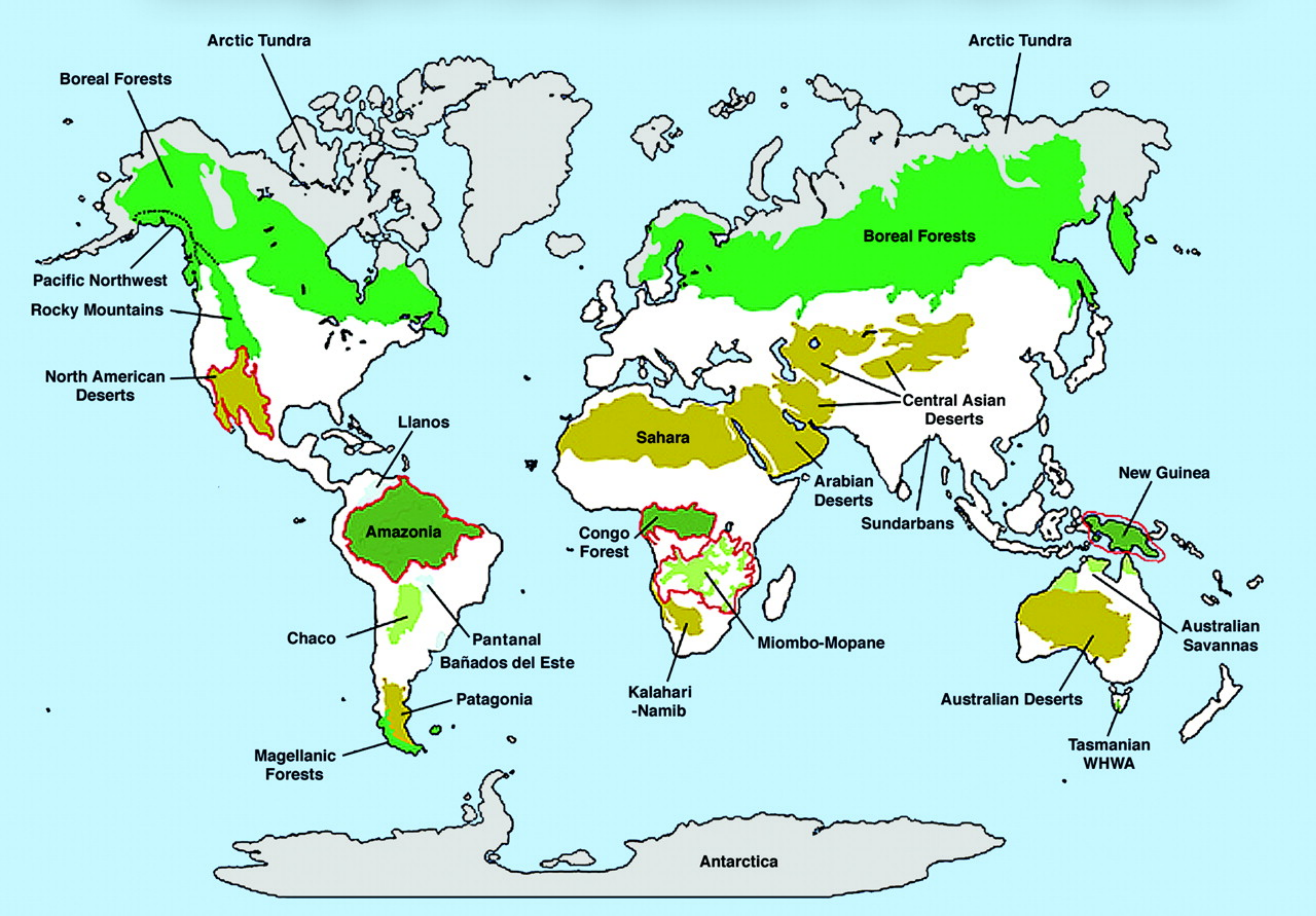
Wilderness
Composed of habitats that have been largely unchanged for c. 500 years and are inhabited by < 5 people/km^2

Novel Ecosystems
Composed of habitats that have been substantially modified over the last 100 - 150 years from their natural states via conversion for human use (e.g., industrial areas, urban and suburban areas, agricultural land).

Historical Ecosystems
Largely operating as they have for 100s of years, but show signs of human modification (e.g., national parks)

Conservation Paleobiology

Ecological Composition of the Planet



Remaining wilderness areas. Of these 24 refuges from development only 5 (21%) are considered to have high biodiversity (= species richness).

Map from Mittermeir et al. (2003)

Conservation Paleobiology

Ecological Composition of the Planet

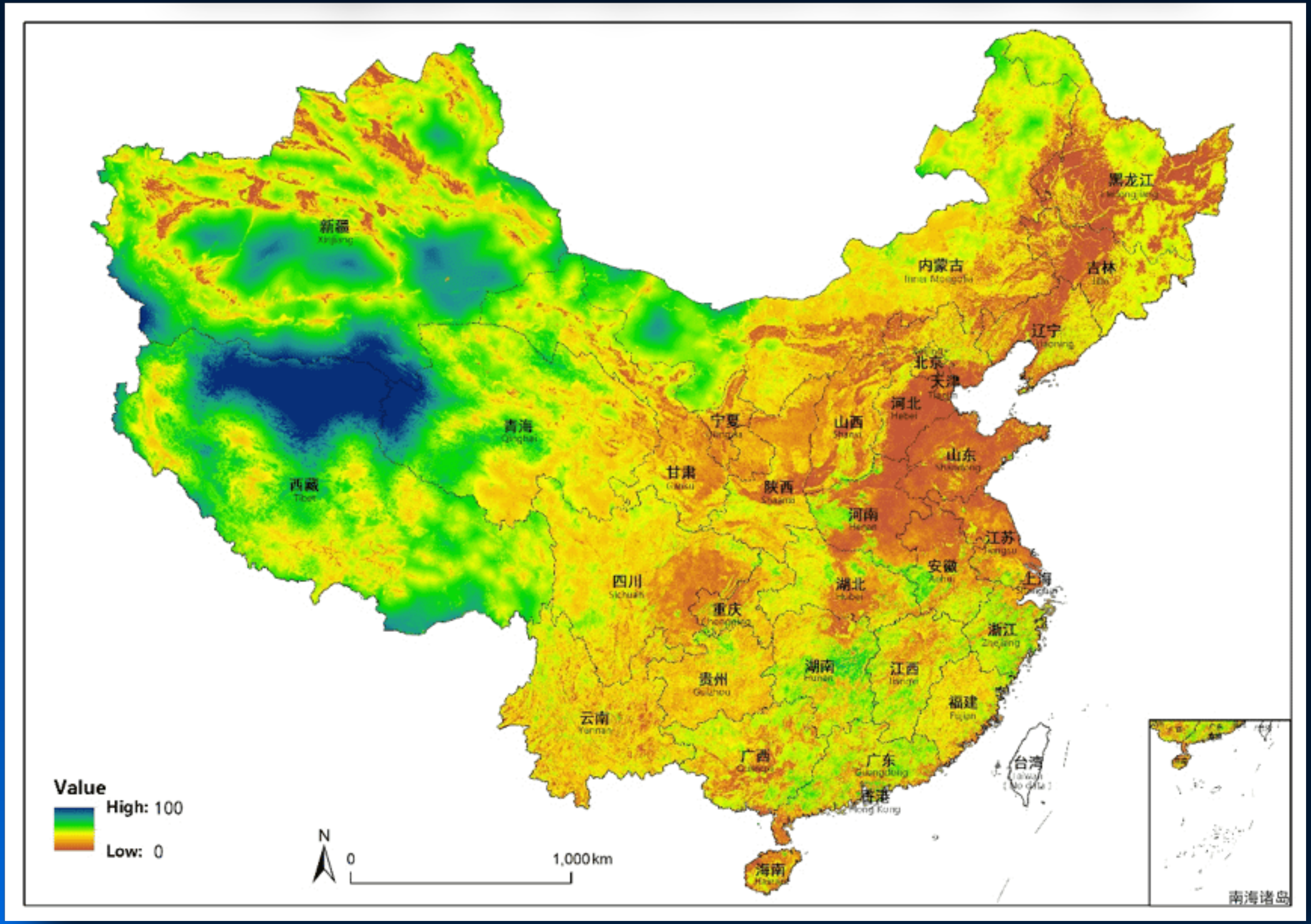
Wilderness Area Characteristics

Biome and wilderness	Area,* km²	Intact,* %	Population† Total	Population† Minus urban	People per km²†	Protected areas,‡ %
Tropical humid forest						
Amazonia	6,683,926	80	21,430,115	7,355,126	1.1	8.3
Congo forest	1,725,221	70	16,000,000	10,000,000	5.8	8.1
New Guinea	828,818	70	6,000,000	4,197,200	5.1	11
Tropical dry forests and grasslands						
Chaco	996,600	70	2,810,000	648,693	0.65	7.5
Miombo–Mopane	1,176,000	90	5,839,000	3,816,000	3.2	36
Australian savannas	585,239	100	60,730	24,188	0.041	11
Mixed mountain, temperate rain, and temperate needleleaf forest						
Rocky Mountains	570,500	70	1,574,986	1,035,174	1.8	17
Pacific Northwest	315,000	80	770,000	597,095	1.9	48
Magellanic forests	147,200	100	253,264	34,501	0.23	72
Tasmanian WHWA	13,836	90	8	8	0.000058	100
Boreal forests	16,179,500	80	30,337,925	15,438,546	0.95	3.8
Wetland						
Llanos	451,474	80	4,444,243	1,065,956	2.4	15
Pantanal	210,000	80	1,125,200	81,200	0.38	2.7
Bañados del Este	38,500	80	200,000	40,000	1.0	2.8
Sundarbans	10,000	80	3,000	3,000	0.30	31
Warm and cold-winter deserts						
North American deserts	1,416,134	80	15,348,342	4,509,403	3.2	23
Patagonia	550,400	70	800,000	200,000	0.36	4.1
Sahara	7,780,544	90	35,187,620	10,273,595	1.3	2.8
Kalahari–Namib	714,700	80	1,422,700	425,900	0.60	25
Arabian deserts	3,250,000	90	47,000,000	15,000,000	4.6	8.3
Central Asian deserts	5,943,000	80	9,000,000	5,500,000	0.93	2.8
Australian deserts	3,572,209	90	400,000	285,000	0.080	9.4
Tundra						
Arctic tundra	8,850,000	90	4,288,613	2,385,713	0.27	20
Antarctic	13,900,000	100	1,000	1,000	0.000072	0.025
Total	75,908,801	90	204,296,746	82,917,298	1.1	7.5

Data from Mittermeir et al. (2003)

Conservation Paleobiology

Ecological Composition of the Planet



Map of Chinese Wilderness Quality Index (WQI) values.

Map from Yue et al. (2017)

Conservation Paleobiology

An Agenda

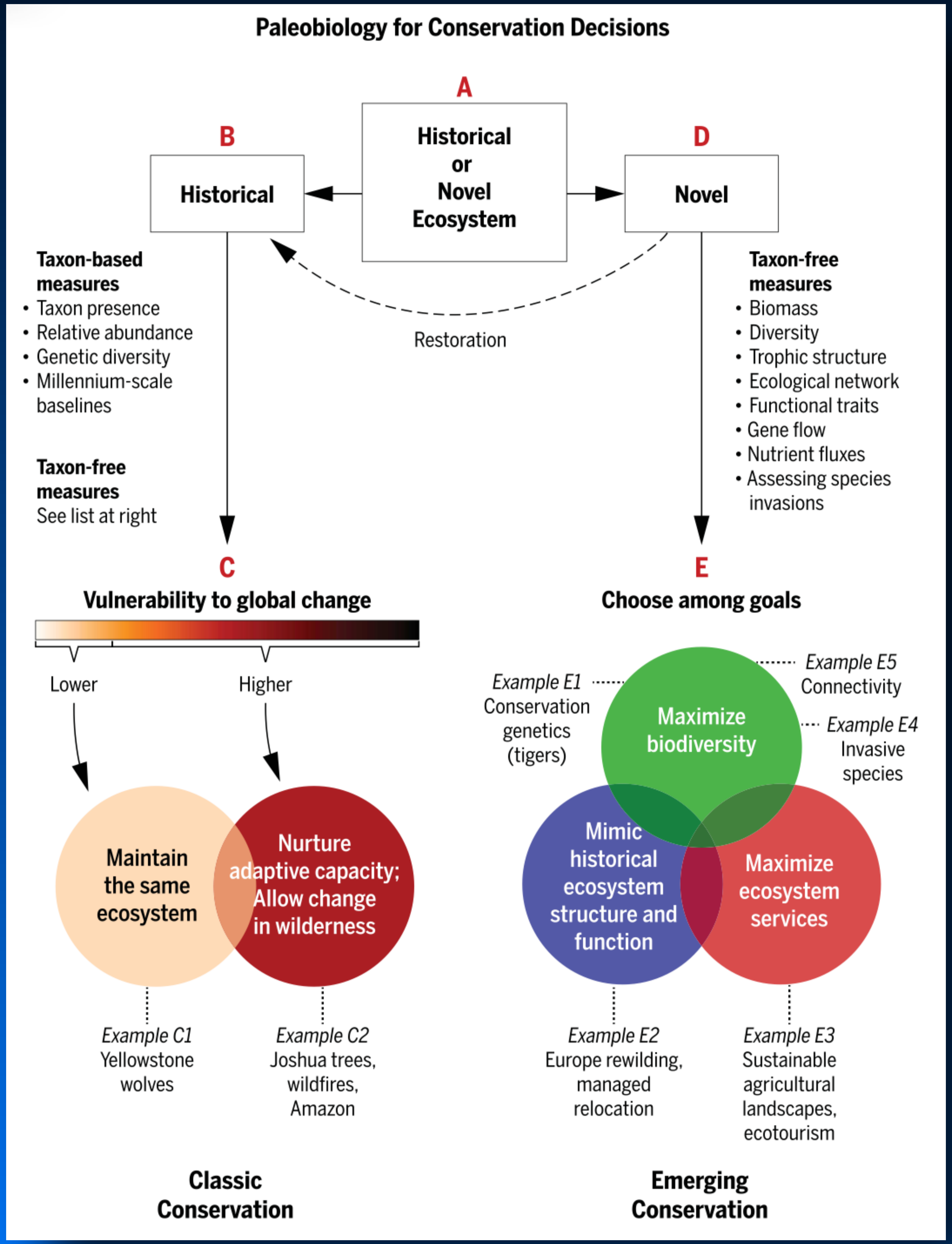

RESEARCH

REVIEW SUMMARY

CONSERVATION

Merging paleobiology with conservation biology to guide the future of terrestrial ecosystems

Barnosky, A.D. et al., 2017, Merging paleobiology with conservation biology to guide the future of terrestrial ecosystems: Science, v. 355, p. eaah4787.



Conservation Paleobiology

Econometric Traits

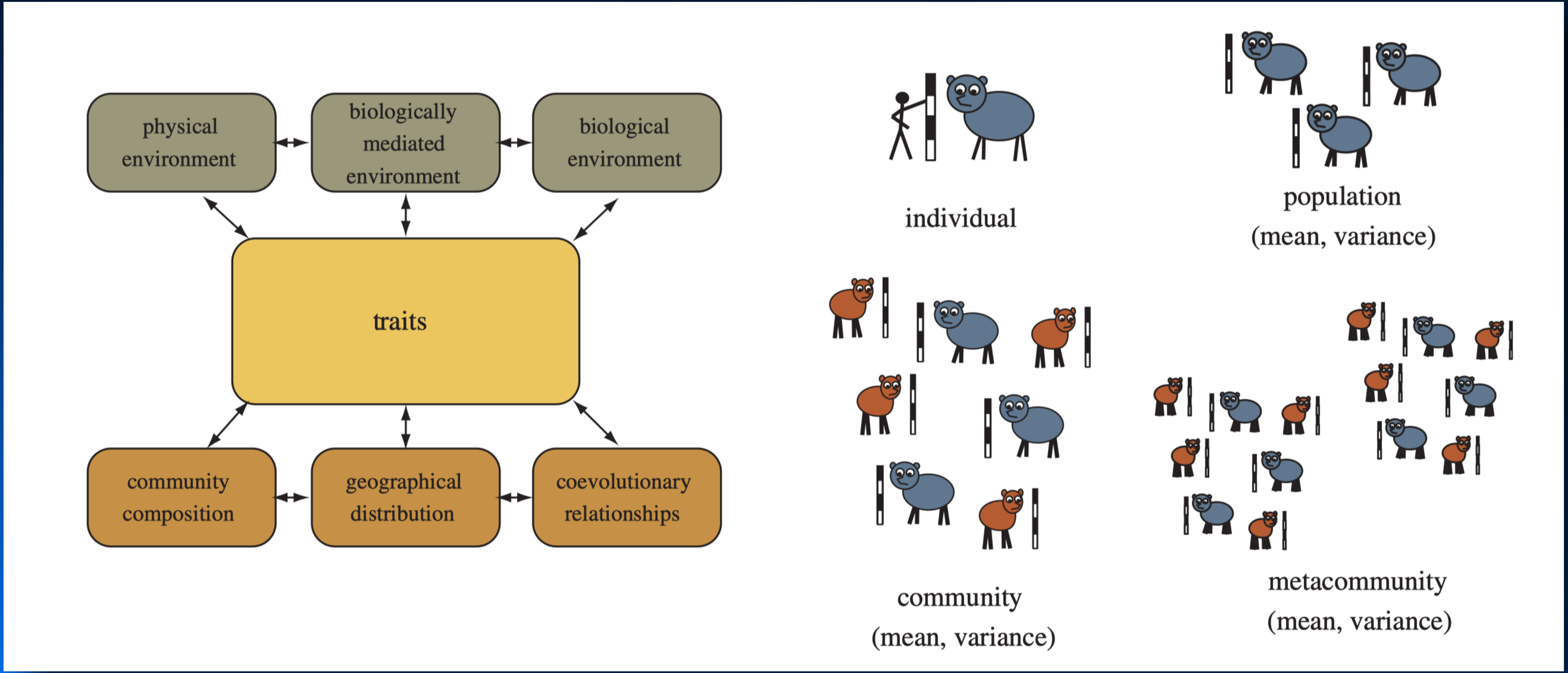


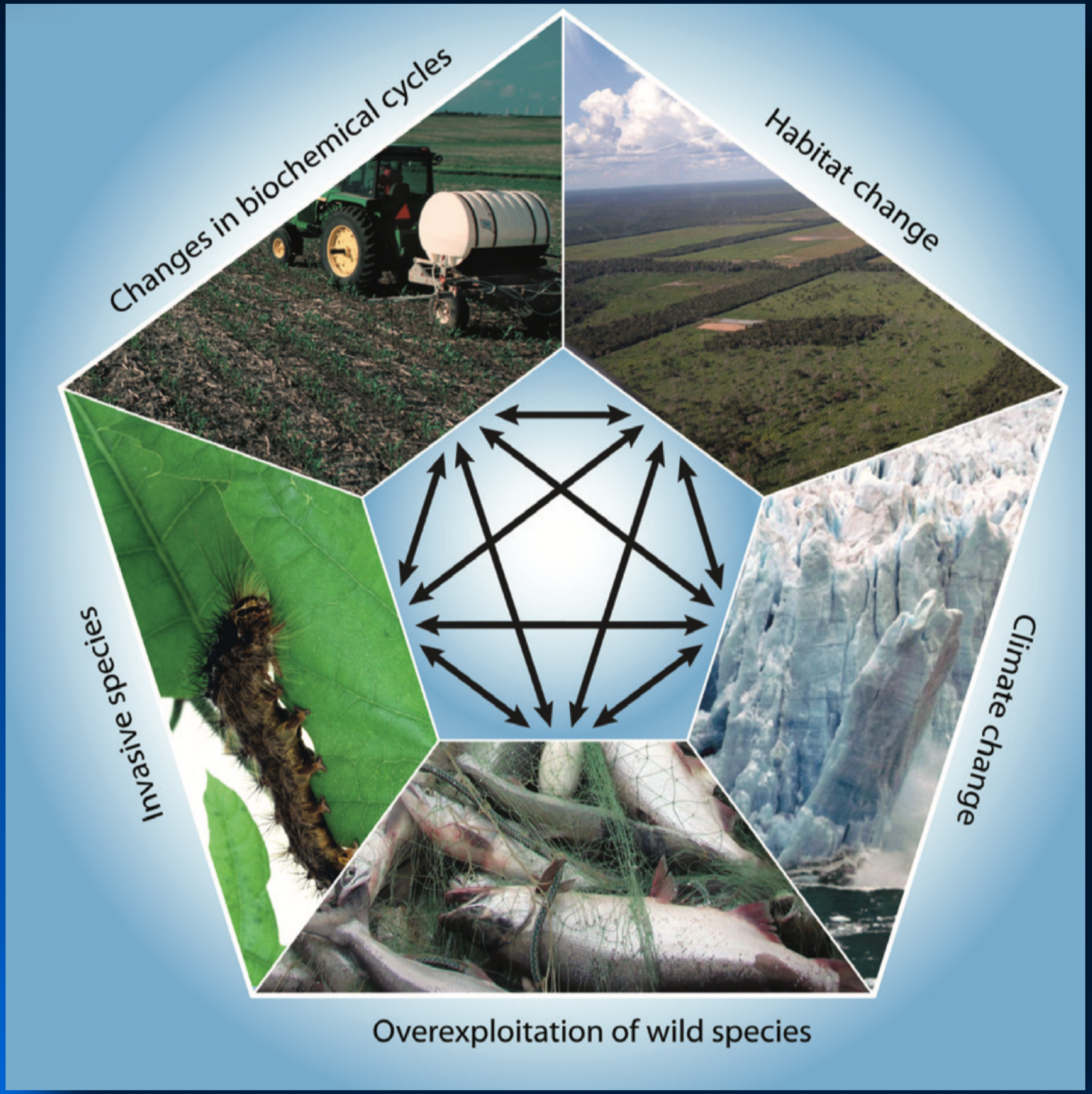
Diagram from Polly et al. (2011)

Conservation Paleobiology

An Agenda

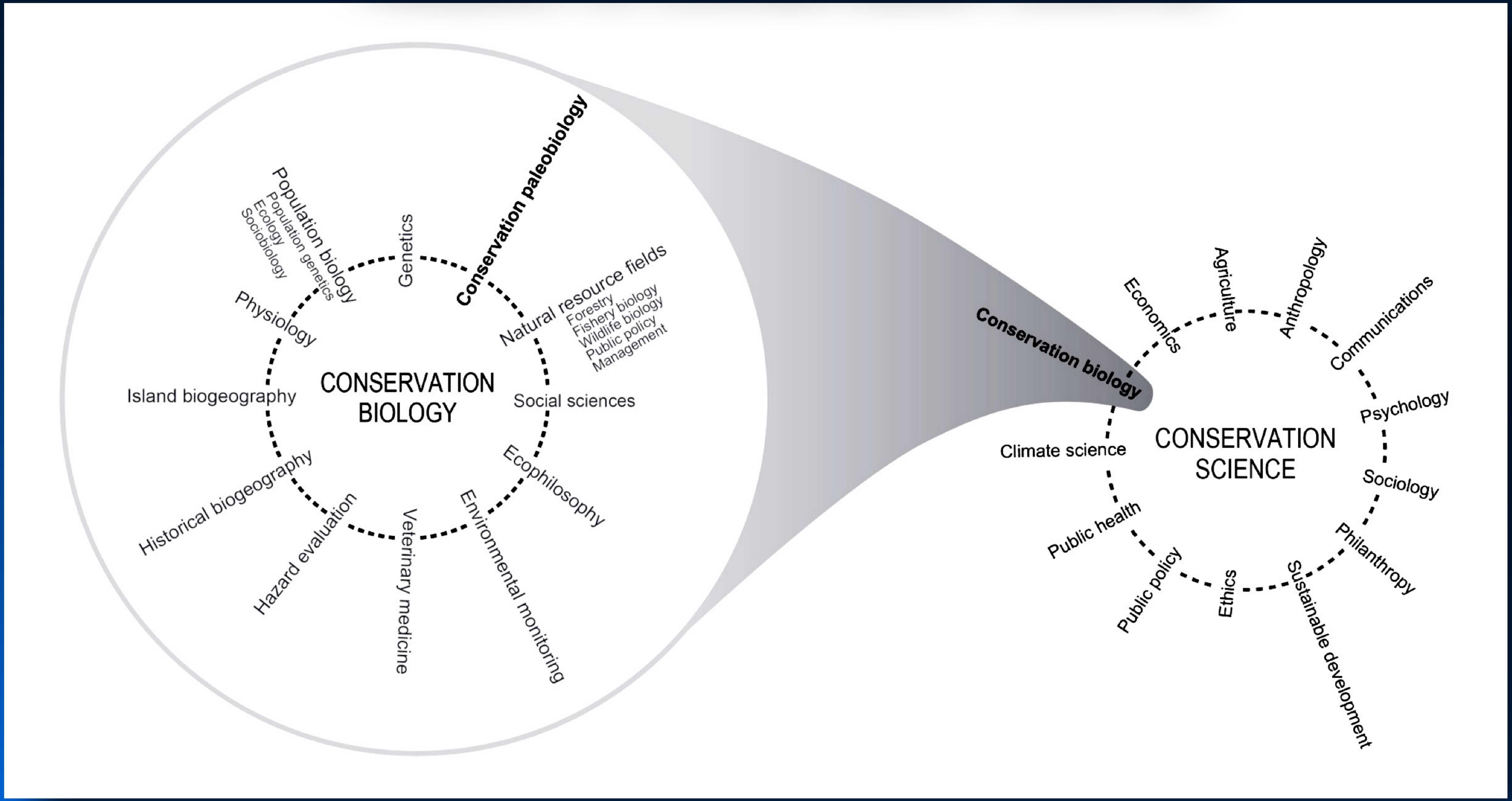
Conservation Paleobiological Contributions

- Document long-term baseline states for all major ecosystems.
- Develop taxon-free metrics that will allow ecosystem states to be tracked over long intervals of time.
- Document the biotic outcomes of various historical “natural experiments” in ecosystem perturbation.
- Develop, test and refine models to predict biotic responses to ecosystem change.
- Document long-term ecosystem dynamics in ways the can be related to the provision of ecosystem services.
- Attempt to discover early warning proxy signs for ecosystem-state shifts.



Conservation Paleobiology

Relation to Conservation Science



To be successful conservation paleobiology needs to be part of an inter-disciplinary and coordinated approach to conservation biology.

Diagram from Dietl (2016)

NJU Course

Principles of Paleobiology

Conservation Paleobiology